Better Pastures for Ohio Livestock

By

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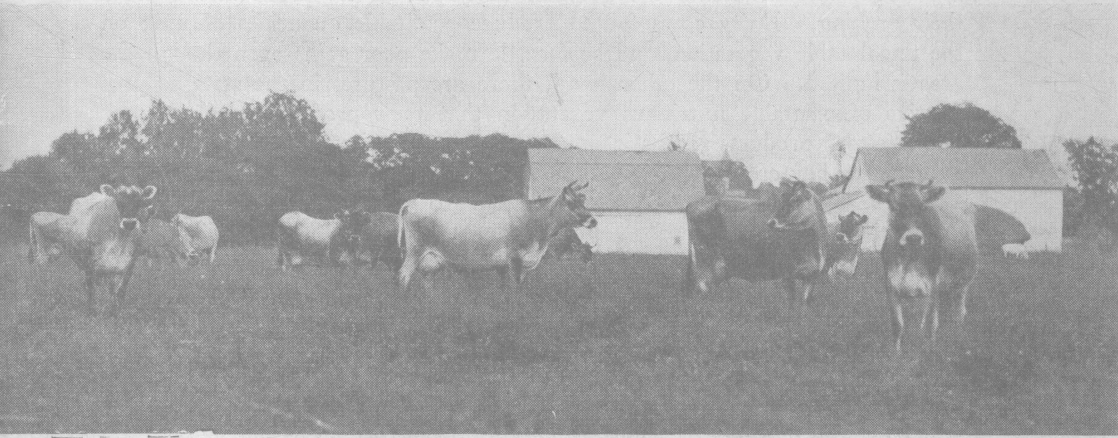

An improved bluegrass pasture on the Trovinger farm, Perry County. The condition of the pasture is generally a good index to the profitableness of livestock enterprises.

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ALTHOUGH pasture contributes much of the feed of most livestock on the average Ohio farm, the amount of feed thus provided is much less than it should be if the livestock is to be maintained in the most healthy condition and maximum farm profits are to be realized. The margin of profit in most phases of livestock production is largely dependent upon the extent to which good pasture is utilized in its production. The returns above feed costs are much greater during the productive pasture months than during the remainder of the year. The condition of the pasture is generally a good index to the profitableness of the dairy and other livestock enterprises.

There are great differences in pastures. Some have become so depleted in fertility and in desirable vegetation that little or no profit results from their grazing. Dairy cows fail to produce profitable quantities of milk on the unpalatable vegetation, and beef cattle make poor gains even though the area is limited. On the other hand, there are pastures in the state so productive of palatable nutritious vegetation that their production of livestock and livestock products results in profits greater than those ordinarily returned by grain or hay crops.

There are probably no other means of so greatly reducing the cost of production of livestock and livestock products, and of so greatly increasing the net farm income, as through improvement in the production and grazing of farm pastures.

Pasture Problems

The chief pasture problems on Ohio farms are: (1) how to produce sufficient high quality pasture; (2) how to produce it at the time it is needed; and (3) how to graze or manage the pasture that it may be maintained in a productive condition.

The purpose of this publication is to assist in the solution of these problems. It is proposed to give suggestions as to how a sufficient quantity of high quality pasture may be made uniformly available throughout the pasture season. Naturally it is recognized that the profits from such pasture improvement are conditioned upon its utilization by good livestock.

Conditions in Western Ohio

In western Ohio, due to the general adaptation of the land to the production of cultivated crops, there is comparatively little permanent pasture. The chief portion of the grazing is obtained from old meadows and special crops such as sweet clover. These old meadow pastures frequently have gone several years without any treatment. This fact, combined with poor grazing practices and a general running-out of the desirable vegetation, has resulted in a condition of low pasture returns. The permanent pastures, while still frequently composed of a fairly good bluegrass sod, have deteriorated in like manner, and

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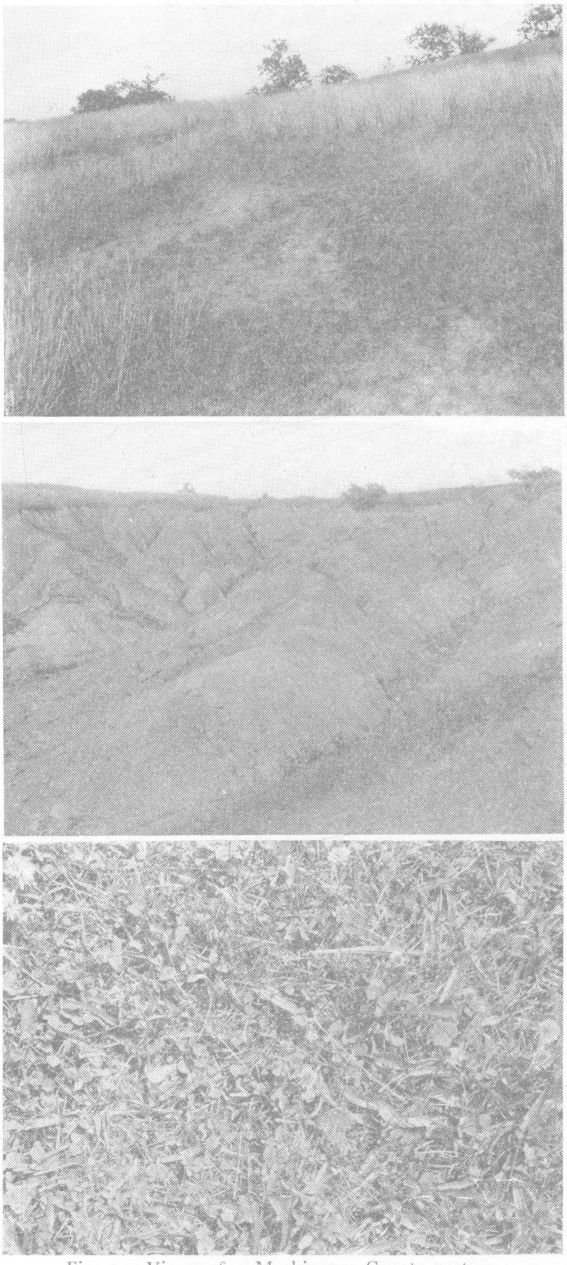


Fig. 1.—Views of a Muskingum County pasture.
Top: Due to lack of nutrients the surface cover has given away and sheet erosion has removed the surface soil. Gullying is about to begin.
Middle: A badly gullied area where the surface cover broke about 25 years ago, illustrating the not distant future of the area at the top.
Bottom: A good productive and protective sod resulting from a fertilizer and lime treatment three years before on an area rapidly approaching a condition like that in the top picture.

in general are much less productive than they should be if maximum profits are to be obtained.

A material increase in the pasture area, and improvement of the production through treatment and better grazing practices, would probably increase the net farm income on most farms in this section.

In this and similar sections elsewhere in the state where the acreage of pasture is limited and where the value per acre is high, an intensive pasture program is justified, provided the increased production can be utilized by good quality livestock.

Conditions in Eastern and Southern Ohio

In the eastern and southern portions of the state there are rather large areas of permanent pasture land, that, because of soil type or topography, are not well suited to general crop production. Generally, these areas were seeded or let go voluntarily to pasture a number of years ago. In many instances when the land was "new" the vegetation was fairly

good, consisting chiefly of bluegrass, redtop, and some white clover. Due, however, to many years without any treatment and the constant removal of nutrients by grazing, leaching, and erosion, these desirable plants have frequently given way to poverty grass, broom sedge, cinquefoil, briars, and bare ground.

The permanent pastures of this area, however, vary so in nature that they should be considered in separate groups.

Potential Timber Land.—First of all, there are included in this so-called permanent pasture land thousands of acres of land that are too steep or rough or that are too badly eroded to be converted into profitable pasture. Half of the so-called pasture land of southeastern Ohio probably belongs in this class. It constitutes a burden upon the true pasture area and, due to erosion, is rapidly becoming less valuable for timber which it once grew well. The sooner it can be reassigned to that purpose the sooner some profit may be realized.

Fig. 2.—Forest trees growing on these Scioto County hills will yield more profit than would be possible from pasture on such steep land.

Many areas of this type, while still being grazed, are being permitted to return to forest of their own accord. This combination use is strongly recommended against, since the returns from grazing, which have been found to be very meager in a woods area, are not sufficient to pay for the damage done in injury to trees and increased erosion of the soil (see Fig. 3). A much better plan generally is to keep the pasture and woods areas separate.

Just what degree of steepness, roughness, or erosion is sufficient to preclude land from the pasture area is difficult to say, since this varies with soil type, the need for pasture on the farm, and the ingenuity of the individual handling of the pasture.

Limestone soils such as the Belmont and Westmoreland erode less and hold sod better than the lighter types of soil such as the Muskingum. Consequently, somewhat steeper slopes of these types may be retained in the pasture area. Roughly speaking, when considering such soils as the Muskingum and Meigs, any slope above 30 per cent may be regarded as unsuited for pasture.

In the case of the Brooke, Belmont, and Westmoreland soils, anything above 40 per cent may be so regarded.

Regardless of slope, improvement for pasture purposes is not advisable if the area is so badly gullied that it cannot be gotten over with the machinery necessary in the process of improvement, or if it is so badly sheet-eroded that the entire surface soil has been removed, leaving only a few inches of subsoil over the parent rock. Under this latter condition the desirable pasture plants burn out during the summer and a satisfactory sod cannot be maintained

While these badly gullied or sheet-eroded areas generally cannot be regarded as satisfactory for the production of good timber, they are probably better suited to that purpose than to pasture. It is well to keep in mind that

Fig. 3.—Grazing the woods area injures the trees and provides little pasture.

sooner or later permanent pastures must be treated, and consequently only land that can be gotten over with equipment for the distribution of plant nutrients and for the control of weeds should be retained in the pasture area. The eliminating factor may be erosion, slope, presence of large rocks, or some other.

Marginal Pasture Lands.—Next are those marginal areas that may be included in the true permanent pasture class but, because of the degree of slope or erosion, produce rather poorly and respond only moderately well to treatment.

It is frequently difficult to justify improvement of such areas if considered entirely from the point of view of pasture returns. If on any farm such an area is surplus unneeded pasture, it also may be wisely assigned to the timber area. If it is retained in the pasture area improvement is necessary for

conservation of the soil. When left unimproved, sheet erosion soon removes the entire surface layer. Once this is gone, gullying rapidly follows, and in the course of a few years the area is worthless not only for pasture purposes but for forestry also.

At the Federal Soil Erosion Experiment Station at Zanesville, between July 1, 1933 and January 1, 1934, a 12 per cent soil slope without vegetation lost in surface run-off 39 per cent of all the rain that fell; whereas a similar slope in fertilized pasture sod lost only 5 per cent. During the same period

Fig. 4.—The fate of some unimproved Ohio pastures: (1) in Noble County; (2) in Muskingum County; (3) in Washington County; (4) in Adams County.

the soil without cover lost 17 tons of soil per acre; whereas the fertilized pasture sod lost less than one-tenth of one ton. Such damage to unprotected soil not only affects the present earning power of the farm, but greatly reduces the sale value and also indicates early ruin if the pasture sod is not improved.

When a pasture area has become so depleted of soil cover that muddy water flows freely from the area following a rain, it is time to be alarmed concerning erosion damage. However, for maximum grazing returns from the pasture, improvement should be made long before this occurs.

True Permanent Pasture Lands.—The third class of so-called permanent pasture in this area includes the truly adapted pasture areas which are in various degrees of depletion and where improvement is generally needed. Here, if the pasture can be properly utilized, improvement will be highly profitable. On the average eastern Ohio farm the area available for pasture is more extensive, and land values are lower than in the western part of the state; consequently, a less intensive treatment may provide all the grazing that can be utilized. Naturally, no definite line of demarcation between sections of the state can be made. Furthermore, many farmers in one section have the conditions as described for another. For example, although northeastern Ohio is a section of rather extensive grazing areas, certain dairy farms may have a very acute need for pasture, and find it necessary to devote

Fig. 5.—A typical pasture in Meigs County. Such land, due to erosion, rapidly deteriorates and becomes unprofitable if used for general farming. However, if properly cared for and utilized as permanent pasture, it will remain indefinitely a source of good income.

high-priced land to pasture purposes. Farmers contemplating improvement of pastures should consider their own individual needs rather than those of the community generally.

What Is Good Pasture?

There is a great difference in the amount of grazing obtained from similar areas of pasture on different farms. Naturally, before beginning on an improvement program, one is interested in knowing what a good pasture should produce, how his own compares with this ideal, and what hope there is of his attaining this ideal.

Cattle finished entirely on grass in certain sections of West Virginia and Kentucky frequently sell on the market at abnormally high prices for grass fed cattle. The soil in areas producing such cattle is known to be high

in lime and phosphate. Carrying capacities for the entire pasture season of one 2-year-old steer per acre of pasture are common on many farms. Occasionally much better records are reported.

In a pasture experiment near Columbus, 1.82 dairy cows per acre were carried on an intensively fertilized bluegrass pasture. These cows were receiving concentrates at the same time but were permitted all the grass they would consume.

In Europe and Great Britain where pasture fertilization is a regular practice and where the problem has been given more study than in America, much of the most valuable lands are devoted to pasture purposes. The average pasture is much more productive than in this country. The climate is more favorable for pasture, but the chief difference in productivity is doubtless due to superior systems of fertilization and management.

Experiments in the Production of Good Pasture

In 1915 a pasture test was started at the Southeastern Experiment Farm at Carpenter. Treatments were made every other year from 1915 till 1927, except in 1925. There has been little change in the check plot since the beginning. A comparison of the various plots in 1932 and 1933 indicates that, with limestone, phosphate, and manure, the clover has changed from less than 1 per cent to 18 per cent; the tame grass from 13 to 71 per cent; and the growth from scant to vigorous.

No Treatment — Growth Scant — pH 5.0 to 5.5

Clover 0.5%	Tame Grass 13%	Wild Grass 48.5%	Weeds 26%	Bare Ground 12%

Limestone and Phosphate — Growth Vigorous — pH 6.8 to 7.5

Clover 17%	Tame Grass 68%	Wild Grass 3%	Weeds 10%	Bare Ground 2%

Limestone, Manure and Phosphate — Growth Very Vigorous — pH 6.8 to 7.5

Clover 18%	Tame Grass 71%	Wild Grass 2%	Weeds 6%	Bare Ground 3%

Fig. 6.—Average composition of soil cover and percentage of bare ground in 1932 and 1933 of pasture plots of different treatment at Southeastern Experiment Farm. Experiment begun in 1915. Muskingum silt loam soil.

In another experiment, records of yield and type of vegetation were kept on tests at 34 different locations in southeastern Ohio. From these data and previous knowledge of the milk and meat producing value of different types of vegetation, it was possible to calculate the possible beef and milk production and the pasture cost per 100 pounds of beef and milk for each of the various treatments. These figures are presented in Table I, and indicate that more beef and milk can be produced with improved pasture, at a decidedly lower cost.

Table I.—1933 Results from 34 Pasture Experiments in Southeastern Ohio

Fertilizer	Average yield per acre, Pounds	*Calculated equivalent production per acre in pounds of		Calculated cost of pasture per 100 pounds of	
		Beef	Milk	Beef	Milk
None	2494	111	1080	$4.05	$0.42
Phosphate	3807	203	1983	2.96	0.30
Complete fertilizer	5835	389	3789	2.71	0.28

* These calculations are based upon the assumption that all the pasture produced could be utilized. Due to seasonal production this is difficult to accomplish.

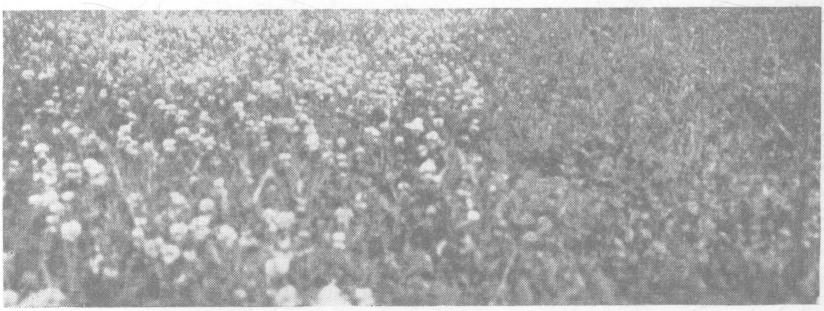


Fig. 7.—White Dutch clover resulting from treatment of pasture with phosphate and potash. Area to the left, treated; that to the right, not treated.

Due to the fact that returns from pasture land are not so direct as from crop land, there is likely to be an impression that pasture lands are less profitable. Under ordinary methods of management this may be true, but it is not necessarily so. Pasture lands can be, and frequently are, the most profitable areas on the farm. More money can frequently be made through the use of lime and fertilizer on pasture land than through similar applications to crop land. This is shown in the yields obtained in cooperative farm pasture experiments in southeastern Ohio, and in a 3-year crop rotation experiment of corn, wheat, and mixed meadow at the Southeastern Experiment Farm in the same section (See Table II). The fertilizer treatments, while not identical, were

liberal, and would generally be regarded as favorable to the rotation experiment.

The average yields in the rotation during 1931, 1932, and 1933 were 52.4 bushels of corn, 23.6 bushels of wheat, and 2.18 tons of hay per acre. These would be generally regarded as quite satisfactory.

In Table II are given the annual and average yields of total dry matter and protein produced by the rotation and by the pastures. It may be noted that while the rotation excels slightly in dry matter, the pasture is decidedly ahead in protein.

Table II.—Yield of Dry Matter and Protein per Acre in 3-Year Rotation of Corn, Wheat, and Mixed Meadow and in Permanent Pasture

	Rotation			Pasture		
	Dry matter	Protein	Average annual cost of production	Dry matter	Protein	Average annual cost of production
1931	5030	377		4902	557	
1932	5128	405		4516	513	
1933	6030	443		5835	663	
Average	5396	408	$20.68	5084	578	$11.59

[1] Pasture figures averaged from 43 tests in 1931, 36 in 1932, and 34 in 1933.

There may be some question as to whether or not the pasture yields obtained from harvests are greater than might be obtained in actual grazing. However, it should also be kept in mind that the yields for the rotation were obtained from a selected area of comparatively level and productive soil that has had good treatment for many years, while those for the pasture were obtained from 34 to 43 locations ranging from level to steep, and originally from very good to very poor in productivity. Furthermore, the pasture yields represent the first 3 years after treatments were begun, as compared to the last 3 years of a long series of treatments for the rotation area. Possibly one should also keep in mind that corn cobs, cornstalks and wheat straw are included in the rotation figures.

It seems safe, therefore, to conclude that pasture properly handled may be expected to yield as much feed as regular field crops in rotation. There should be no hesitancy, therefore, in using level, well adapted crop land for pasture, if it can be spared from the crop area necessary for the production of required winter feed and if the pasture can be utilized. The limit of general crop production should be determined more by how much of the regular harvest crop it is *necessary* to produce rather than how much it is possible to produce.

Pasture improvement offers a way to better farm incomes, less work, and more productive wealth for the future. It must be kept in mind, however, that only with a well balanced and well managed pasture program can the full production be utilized and maximum profits obtained.

The Problem of Seasonal Production

It has been pointed out that pastures can be made to produce much better than they are now generally doing and that, where such production can be utilized, farm profits can be greatly increased. There are, however, certain very definite problems of utilization. This comes about because of the natural tendency of our common rotation and permanent pasture plants to make their maximum production early in the season. Second year sweet clover is a heavy producer during the early part of the season, but is gone by early July. Bluegrass probably produces 60 per cent of its total season production by the middle of June. To increase the yield of such pastures by fertilization may serve only to give more pasture when there is already a surplus. Any pasture program must therefore take into account the time of production and whether or not the production can be utilized before it is wasted.

Fig. 8.—Pasture scene on the farm of Kraus and Blackmore in Miami County.

"There should be no hesitancy in using level, well adapted crop land for pasture if it can be spared from the crop area necessary for the production of required winter feed, and if the pasture can be utilized."

Among the factors influencing time of production are:

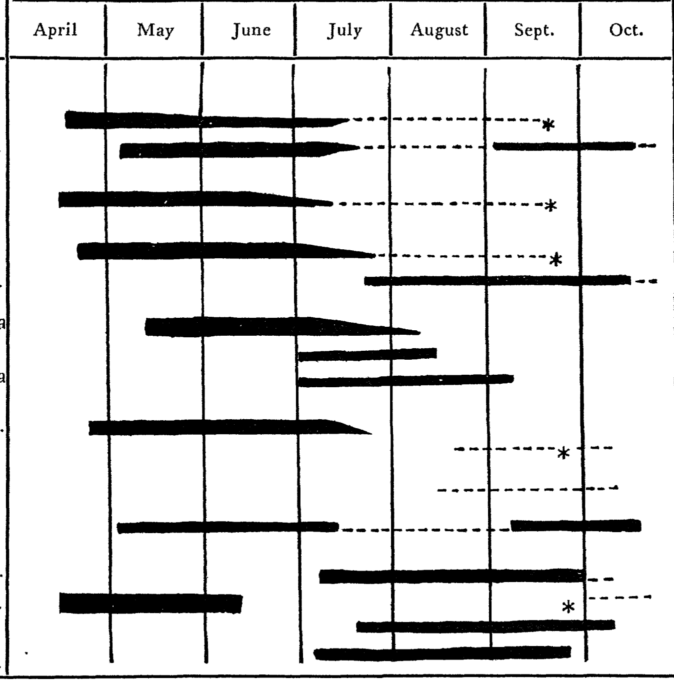
1. The natural tendency or habit of the pasture plant.
2. The weather—particularly the moisture supply.
3. The soil type and nature of soil cover.
4. The time and method of fertilization.
5. The time and method of grazing.

The Natural Tendency of Plants as a Factor in Time of Production.—The tendency of bluegrass and second year sweet clover to produce early in the season has been mentioned. Sudan grass, soybeans, millet, and certain other plants, however, make heavy growth in July and August. First year sweet clover, new meadows, August seeded rye, and certain other crops make heavy growth in the late fall. Rye, orchard grass, alfalfa, and second year sweet clover are extra heavy growers in the spring of the year.

This natural tendency of plants is further illustrated in Table III, and from this list may be selected a combination that will provide for a more or

Table III.—Pasture Crops with Time and Intensity of Production and Carrying Capacity

Crop	Time of Grazing (April, May, June, July, August, Sept., Oct.)	Carrying capacity per acre in cows or equivalents	Notes
Early nitrogen-treated bluegrass	*	3	Grazing alternated
Phosphated bluegrass. .		1½	Grazing alternated or continuous
Early nitrogen-treated orchard grass.	*	3	Grazing alternated
Early nitrogen-treated timothy	*	2½	Grazing alternated
Early-cut meadows. . . .		½–1	Grazing alternated or continuous
1st & 2nd growth alfalfa		1½–2	Grazing alternated
2nd growth alfalfa. . .		1–1½	Grazing continuous
2nd & 3d growth alfalfa		1¼	Grazing alternated or continuous
Sweet clover 2nd yr. . .		2	Grazing continuous
Sweet clover 1st yr. . .	*	1	Short period grazing
New meadows		1	Short period grazing
Old meadows		1–1½	Grazing alternated or continuous
Sudan grass.		3	Grazing alternated
Rye	*	1–2	2 short periods grazing
Korean lespedeza . .		1	For southern third of Ohio only
Millet		1½–2	Not so good as Sudan grass



* If these crops are not to be used for early spring pasture the following spring they may be used for heavier and later grazing in the fall.

▬▬ Heavy production ------- Light or doubtful production

less uniform production. It should, however, be kept in mind that the time and amount of production may be greatly influenced by previous treatment such as close grazing of rye and sweet clover the previous fall, or heavy early grazing of alfalfa. Overgrazing of new meadows in the fall will also be very detrimental to the yield the following year.

Effect of Climate and Precipitation on Time of Production.—Climate, of course, restricts certain plants to certain areas; as for example, lespedeza to the southern part of the state. Moisture is very commonly a disturbing factor. The close relationship of bluegrass growth to precipitation is shown in the results of an experiment conducted by the Ohio Agricultural Experiment Station on a farm near Dayton. These results are presented in Fig. 9, below, and indicate clearly that bluegrass grows whenever moisture conditions are favorable, even though probably not to so great an extent later in the

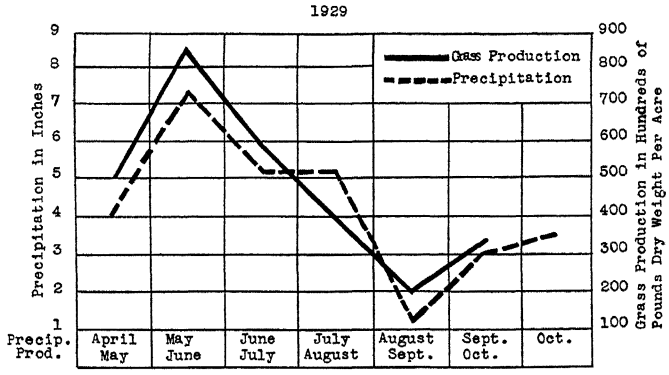


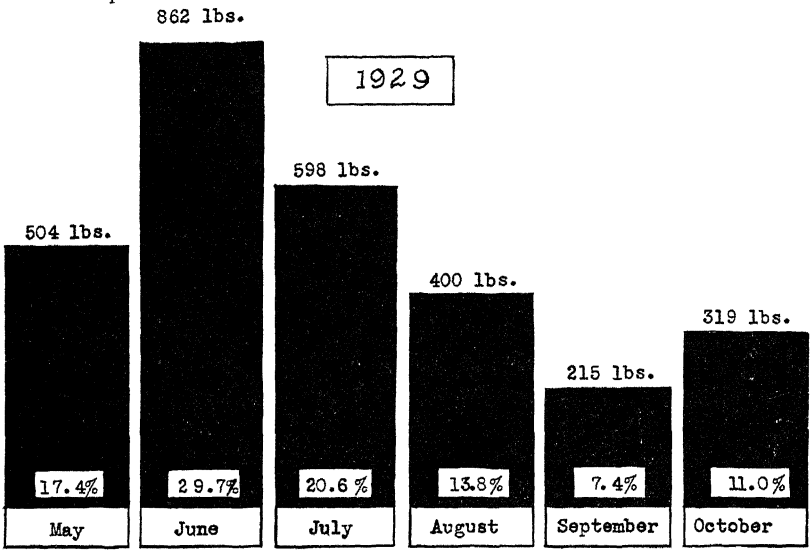
Fig. 9.—Correlation between precipitation and grass growth as indicated by grass harvests the following month.

season as earlier, due to temperature and the natural tendency of the plant. It may be noted from Fig. 10 that in 1929 about 14 per cent of the season's production occurred in August and 7 per cent in September, while in 1930 only 4 per cent occurred during August and 25 per cent during September.

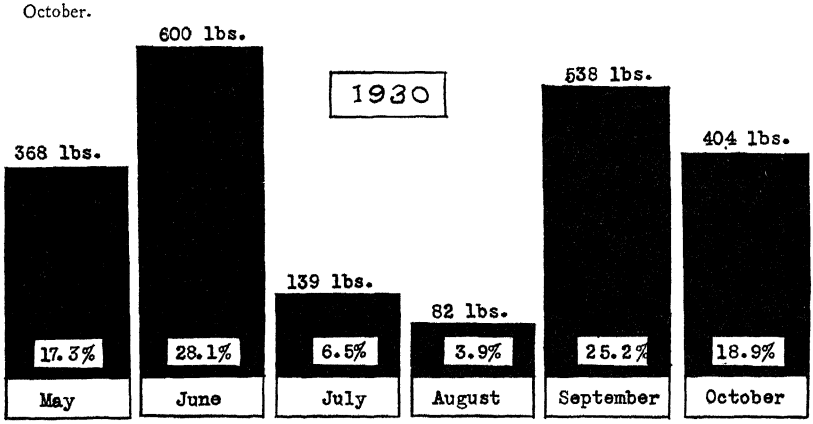
It has previously been pointed out that one-fourth or more of the rainfall frequently is permitted to run off, which might be conserved by a better type of sod.

Effect of Soil Type on Time of Production.—The soil type frequently is a factor in the time of maximum pasture production. Upland soils such as the Miami, Muskingum, and Meigs dry out rapidly, and frequently are almost barren of green grass when lowland soils such as the Brookston, Pope, Genesee, Wabash, and Huntington are producing good grazing. It has been previously shown that the more productive soils are capable of producing as great or greater returns in pasture as in crops for harvest, and it is a wise plan to devote such of them as may be needed to pasture. Incidentally this is also a good way of handling the weed problem on badly infested areas of crop land, particularly where clipping and systematic grazing is practiced.

Effect of Fertilization on Time of Production.—Nitrogen fertilizers tend, under favorable weather conditions, to produce their maximum effect soon after application. Extra early spring growth may be produced by a supply of available nitrogen at that time. Pasture plants may fail to respond with extra production to midsummer fertilization due to the limitation of



Basic treatment—300 lbs. 0–14–6 early in April
Nitrogen treatment—450 lbs. nitrate of soda, generally in 100-lb. applications at 40-day intervals, beginning April 14.
Rainfall 7.4 inches above normal for May, June, and July, and below in September and October.



Basic treatment—300 lbs. 0–14–6 per acre in 1929.
Nitrogen treatment—300 lbs. nitrate of soda in 100-lb. applications at 40-day intervals, beginning April 1, but interrupted during the drouth period of July and August.
Rainfall 5 inches late in August. September dry. May very dry. June dry.

Fig. 10.—Production of Kentucky bluegrass in pounds per acre by months. F. G. Stroup farm, Clark County. (The first figure in each column represents the yield, the second the percentage of the season's production.)

moisture. However, returns at this time may be more real than apparent. For example, in 1930 there was little growth resulting from nitrogenous fertilizer in July and August in an experiment near Dayton, but at the end of the season it was found that the vegetation produced was richer in protein and that the cattle grazed had done much better than the amount of pasture production indicated they should.

This same effect has been noted in other experiments in other sections of the state. In 1933, at the Trumbull County Experiment Farm, nitrogenous fertilizer increased the average protein content of grass produced before July 10 from 10.9 per cent for the no nitrogen area to 13.7 per cent for the nitrogen treated area. For the grass produced after July 10 the increase was from 12.3 per cent for the no nitrogen area to 19 per cent for the nitrogen treated area. Thus the increase was 2.8 per cent before July 10 and 6.7 per cent after July 10.

Under otherwise favorable growing conditions, nitrogenous fertilizer brings about large increases in the yield of vegetation but small increases in the percentage of protein. Under unfavorable growing conditions the reverse is true. Fertilizers on pasture areas are undoubtedly giving greater returns in meat and milk during dry seasons than is generally judged from the apparent growth. While it is possible to increase the production and protein content at certain times by providing available nitrogen and other nutrients, better results will be obtained if such fertilizer applications be made to plants that have a natural tendency to produce at the desired time.

Effect of Grazing on Time of Production.—The plant food with which pasture plants increase their top and root growth is manufactured in the blades or leaves. If blades or leaves are few and small, little plant food is manufactured and growth of top and root is slow. If all the top is removed new growth must come from plant food stored in the roots. If the new growth is at once removed, the food in storage is soon exhausted and the plant dies. A prolonged period of close grazing is always followed by a perior of low production, while a period of light grazing will be followed by high production. Consequently, if early spring grazing is desired, the pasture plants must go into the winter with good root reserves with which to start vigorous spring growth. Continuous close grazing from early spring till midsummer results in plants of low vitality at that time. Due to weather conditions this is a very trying period for pasture plants, and they are likely to produce very little or even die during July or August.

If midsummer pasture is desired, the plants should have a chance to build up reserves just prior to that period. The same holds true for all periods of the pasture season and for all of our common pasture plants.

Bluegrass and certain other of our pasture plants, however, if moderately grazed—that is, to a height of 2 to 3 inches—develop a thicker sod, and thus the extra blades compensate for the lack of extra length. Under such management continuous grazing may be practiced, with fairly uniform production so long as other conditions are favorable for growth.

Procedure in Providing Continuous Good Pasture

CONSIDERATION of the facts previously presented forces us to a realization that a uniform supply of good pasture may necessitate attention to several different problems, such as (1) improvement of the general pasture area, (2) provisions for early spring pasture, (3) provision for summer pasture, (4) fall pasture, (5) weed control, (6) rotational grazing, and (7) establishment of new pastures. In the following pages will be presented some specific recommendations concerning these problems.

IMPROVEMENT OF GENERAL PASTURE AREA

Treatment of Permanent Pastures.—The use of fertilizers on pastures marked by deficiency in lime has given small and unsatisfactory returns. For this reason where lime is needed, it is the proper starting point in the improvement of permanent pasture areas. The amount needed should be determined by testing the soil. County agricultural agents and vocational agriculture teachers will gladly assist in making such determinations. The application may be made directly to the soil surface at any convenient time. This is usually in the summer or fall. On steep land or where the vegetation is thin, grooving with a disk harrow will permit better incorporation of the lime in the soil. Ordinarily, however, surface applications without incorporation will suffice. The application should be repeated when needed as determined by the type of vegetation and further soil tests. Generally this will be about every six or eight years.

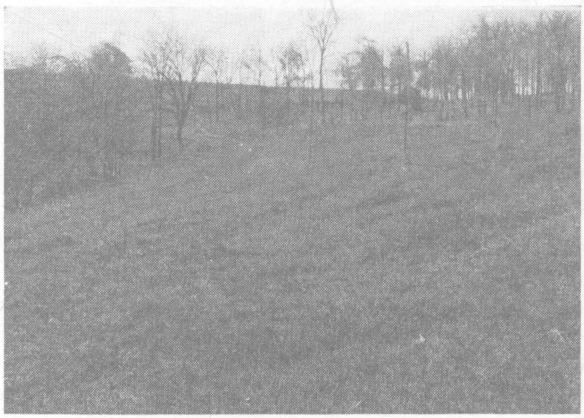


Fig. 11.—A good hillside bluegrass pasture produced by limestone and superphosphate on Muskingum soil on the Belmont County Experiment Farm.

The next step is the application of fertilizer, which should consist of 300 to 500 pounds of 20 per cent superphosphate or 0-14-6 fertilizer per acre. This should be placed in the soil 1 to 2 inches deep by means of a disk drill. The time of application is relatively unimportant. Quickest results may be expected from an application very early in the spring, but this frequently is not the most convenient time. In most cases the superphosphate seems to give about as satisfactory results as the 0-14-6 and costs less, but on certain soils, particularly in northeastern Ohio, the 0-14-6 has shown up better.

This application should be repeated about every 4 or 5 years. Equivalent amounts of higher analysis fertilizers are equally satisfactory.

Reseeding generally will not be necessary, since the content of desirable grasses and clover will rapidly increase following treatment. However, where rapid improvement is desired or where the content of desirable grass and clover is below 5 per cent, reseeding with about 5 to 10 pounds per acre of the following seed mixture is advisable: 7 pounds Kentucky bluegrass, 4 pounds timothy or orchard grass, 3 pounds red top, 3 pounds alsike clover, and 1 pound white clover. Since early fall seeding of grasses frequently gives best results, the grasses may be seeded at that time and the legumes in the early spring or all may be seeded at one time in the spring. Close grazing just prior to or following reseeding and a light disturbance of the soil at seeding time, especially in the fall, further increase the chances of success.

In the southern half of the state, 2 pounds of Korean and 2 pounds of Japanese lespedeza may be added to the seed mixture or used separately. These have particular value in the southern two or three tiers of counties where they supply additional mid-season grazing. The seeding may be made very early in the spring on the old inferior pasture sod without any previous preparation of the soil.

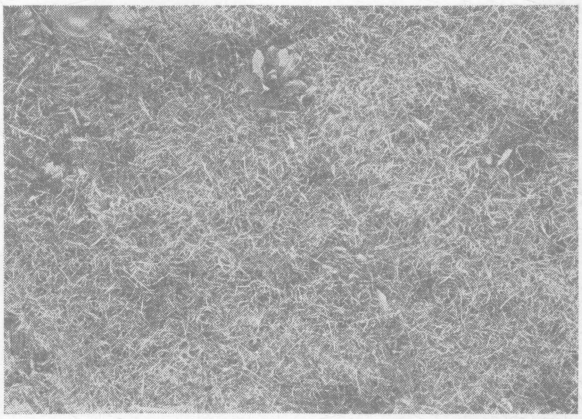


Fig. 12.—A typical poverty grass sod on May 4.

Sometimes, as may be noted in Fig. 12, the mat of poverty grass is so heavy that fertilizer cannot be incorporated nor can the new seeding make a start. Occasionally, too, weeds are so much of a problem that it seems more desirable to make a fresh start. Where such a condition exists and where erosion is not a serious problem, the area should be plowed or disked and re-established after the manner discussed on page 30.

Grazing and Care of Permanent Pastures.—Since the ideal condition for the most nutritious herbage and maximum growth of permanent pasture is one where the herbage is 2 to 5 inches high, and since livestock do not of their own accord keep the grass in this condition, there must be a very definite program of management and grazing. White clover, yellow trefoil, hop clover, and even the lespedezas will be crowded out if the grass becomes too large, as sometimes results from applications of nitrogenous fertilizers. These legumes in the respective territories in which they are adapted gather nitrogen from the air and produce a better growth of grass. They also enrich the

nitrogen and mineral content of the herbage because of their presence in it. If under otherwise favorable conditions for clover the area is continuously grazed shorter than 2 inches, the grass suffers more than the clover and the pasture will be predominately a white clover pasture, which is higher than needed in protein and rather low in yield per acre.

In order to provide the ideal condition which gives the desirable percentage of legumes and grass, alternate or rotational grazing is desirable. The area in question which has attained a height of 4 to 5 inches may be grazed off quickly to 1½ to 2 inches, and the stock then removed to give it a chance to recuperate. If patches remain ungrazed these should be moved so

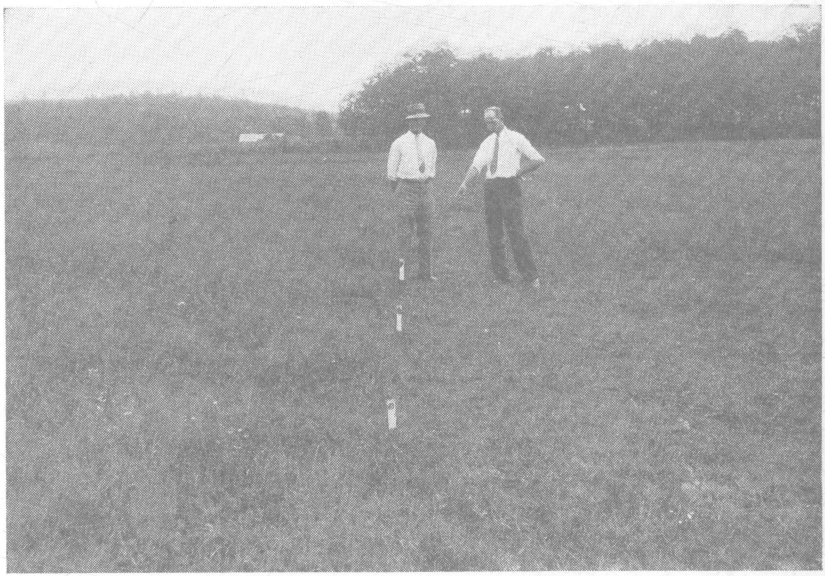


Fig. 13.—Pasture demonstration on the farm of Dr. S. J. Rigdon, Adams County. Cattle prefer fertilized grass. Note that they stopped grazing at the edge of the fertilized area, indicated by the line of stakes, as though there had been a fence.

as to force the development of a new, more palatable growth and prevent the smothering of the clovers.

Where continuous grazing is necessary, the mower should be used in the same manner and care should be taken not to overgraze. Whenever the livestock keep the area uniformly grazed to a height of less than 2 inches for more than a few days, the pasture is being injured and recovery will be slow and yields low. Overgrazing for a period of several weeks early in the season may practically eliminate further production during the season. Overgrazing one season may also reduce production of the following year by one-half or more. Many cases in which farmers have failed to get the response they expected from fertilizers on permanent pastures can be accounted for by overgrazing or other types of improper management.

Harrowing Permanent Pastures.—Productive pastures frequently become quickly spotted with heavy clumps of grass about numerous dung piles where livestock refuse to graze. Not only is this grass wasted but no grass grows on the area of the dung heap for one or two years. These droppings may be turned from a liability to an asset if they are scattered evenly over the area by harrowing. Where alternate or rotational grazing is practiced, this operation may follow the removal of the livestock. The manure thus evenly distributed is soon washed into the sod and increases the new growth uniformly over the entire area.

There is available on the market a "chain harrow" made expressly for the purpose of spreading dung piles on pasture land (see Fig. 14). A good substitute is an ordinary spike tooth harrow with brush tied underneath.

Except for the scattering of the manure, and the incorporation of phosphate and potash fertilizers and sometimes lime, there appears to be no

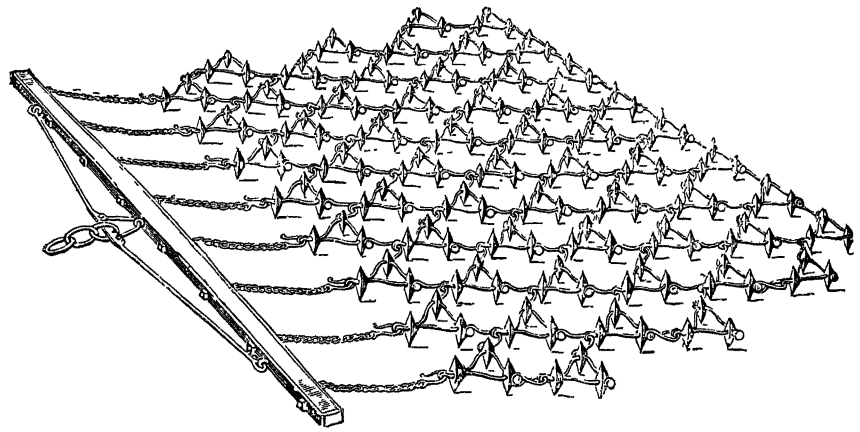


Fig. 14.—Chain or flexible pasture harrow.

particular advantage in harrowing, disking, or otherwise cultivating permanent pastures.

Old Meadows as Pastures.—Where grass meadows are to be maintained a second and third year for pasture, the fertilizer application at the time of establishing them should not be less than 350 pounds per acre, or if preferable an application of 200 to 300 pounds of 20 per cent superphosphate or 0-14-6 may be used early in the spring of the second or third year, after the manner recommended for the permanent pasture area. Should still further improvement or heavier production of either the permanent pasture or meadow pasture area be desired, it can be accomplished by annual applications of 200 to 300 pounds of sulfate of ammonia or equivalent amounts of other quickly available nitrogen carriers in March. If cynamid be used, it should be applied about two weeks earlier than sulfate of ammonia in order to get production at the same date. The amount of the application will depend upon the additional amount of grazing needed.

Another possibility is to use a 10-6-4 fertilizer at the rate of 200 to 300 pounds per acre annually in late March or early April in place of the other fertilizers suggested. However, the use of nitrogenous fertilizer on areas with a poor stand of desirable plants is questionable from an economic point of view. Generally, the first treatments should be with 20 per cent superphosphate or 0-14-6. Equivalent amounts of higher analyses may be used instead of any of these mentioned.

Should the meadow retained for pasture be a mixed meadow of alfalfa and grass or alfalfa alone, no nitrogenous fertilizer should be used. The application of phosphate or phosphate and potash, however, should be as suggested for the grass meadow pasture.

Rarely is there such a thing as just enough pasture. One either has too much or not enough and the former condition is the desirable one. It is frequently advisable to hold one field in reserve which may be used for pasture if necessary, or for hay if not required for pasture.

It should also be kept in mind that because of the more upright habit of growth, old meadow pastures of either the grasses or legumes cannot be grazed as closely as the permanent grass pastures. Best results are obtained when a height of 5 or 6 inches is maintained. It is also generally advisable to hold up grazing on both the meadow pasture and permanent pasture areas in the spring till good growth has been made. This will usually be about corn planting time. An exception to this rule is the specially treated early spring grazing area.

Manure on Pasture Land.—There are several reasons why manure is not extensively used on permanent pasture fields. It is probably more efficient on crop land where it can be better incorporated in the soil. It is objected to by the grazing livestock, and, when not properly applied or under poor conditions of management, it appears to encourage development of the larger type of pasture field weeds. However, where it is available, it may be an effective means of pasture improvement. Each ton should be supplemented with 30 to 40 pounds of 20 per cent superphosphate or its equivalent. This combination may be used in place of the other fertilizers mentioned on either the permanent or meadow type pastures, and it provides a convenient place to haul manure during the summer when it cannot be taken to crop land. The usual rate is 6 tons per acre. On permanent pastures this may be repeated every three or four years.

The practice has much to commend it to the dairy farmer under present economic conditions and where intelligently used is a very desirable practice. If only one-third or one-fourth of the pasture is covered each year the livestock will have other area on which to graze and the manured area will come on later in the year or the following year, depending upon the time of application, with vigorous production. The manure helps by both protecting from grazing for a time and providing extra nutrients, and probably also increasing the moisture holding capacity of the soil.

The uneven growth and high weed content resulting from manure, can, to considerable degree, be controlled by grazing with both cattle and sheep thought not necessarily at the same time.

Early Spring Pasture

Early spring grazing may be provided through treatment of a permanent or meadow pasture area, or by means of special crops. The permanent pasture is generally most satisfactory.

Nitrogen-Treated Permanent Pasture.—Early growth of the permanent pasture is dependent upon good root reserves, some surface protection, an abundance of available nutrients, and favorable weather conditions. The root reserves and surface protection are provided by fall growth. Consequently, the area held for early spring grazing should not be closely grazed in the late fall of the preceding year, especially over any considerable period of time. This area should consist of a good sod that has been liberally fertilized with phosphoric acid and manure or potash from time to time as outlined for the

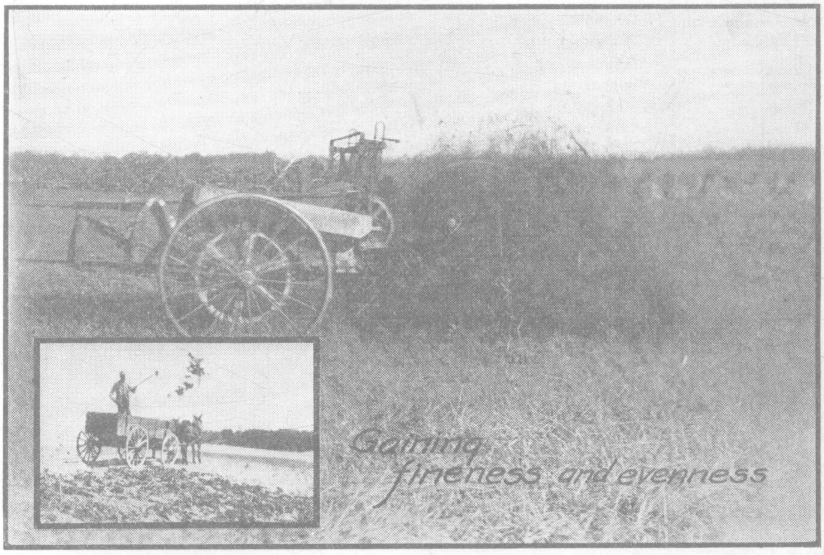


Fig. 15.—Manure applications on pasture should be fine and even, otherwise the growth will be uneven, weeds are likely to come in, and livestock will reject the pasture for some time following application.

general pasture area. In addition, it should receive 200 to 300 pounds of sulfate of ammonia or its equivalent in other nitrogen carriers very early in the spring, the quantity depending upon the amount of extra pasture required. This fall protection and March nitrogen fertilization will advance the possible date for beginning grazing in the spring by two weeks. One-half to one-third as many acres as there are animal units to be grazed should be provided.

This area, which may be the same every year, should be fenced separately so that animals may be turned on and off at will. After the grass is eaten down, the livestock should be turned off until it has again made a growth of 4 to 5 inches. These periodic grazings may be continued as growth justifies through the season.

Timothy Meadows.—Timothy meadows with a good sod may be treated and used in this same manner. The growth in the previous fall and before grazings, however, should be proportionally larger. Legume or mixed meadows also may be used, but in such event the nitrogenous fertilizer application should be omitted. Due to the demand for legumes as hay for winter, such areas are not generally used for pasture.

Rye and Wheat.—Eight pecks of rye seeded in late summer or early fall provides good grazing very early in the spring. Winter wheat may also be used for this purpose. It cannot be seeded so early and provides less pasture in the fall, but remains in good grazing condition longer in the spring than rye. Where the growth is very rank and in danger of lodging, grazing of

Fig. 16.—High yield of pasture provided by sweet clover makes it a valuable pasture crop, especially in the western part of the state where it is well adapted and where rotation crops provide much of the pasture.

the regular wheat or rye may be of benefit in increasing the grain yield as well as in providing pasture. Producers of early lambs frequently follow this practice. Such crops should be fertilized when seeded with 250 pounds of a 2-14-4 or 2-12-6. An early spring application of 100 to 150 pounds of nitrogen fertilizer will also prove effective in producing additional grazing.

Sweet Clover.—On land that is adapted to the crop, sweet clover seeded 15 pounds per acre in a grain crop the previous year serves well for this purpose. Caution should be used with all the legumes to prevent their causing bloat of the animals. Livestock should not be turned in the first time when the plants are wet nor when the animals are hungry. A good plan is to give the animals a full feed of dry roughage or grain before turning in.

Access to an old straw or hay stack or grass pasture at the same time that sweet clover is being grazed is also good practice.

Once grazing has been started it should be continued without interruption, regardless of weather conditions. However, in case the animals are removed for several hours, as will be the case with dairy cows, the same precautions must be observed when they are again turned in. Where special pastures are depended upon for the entire pasture season, sweet clover has much more of a place, since it continues to provide good grazing during the main pasture season till about the middle of July. Under such conditions it probably has no superior.

Summer Pasture

The summer period is generally the most troublesome. If the regular pasture is fertilized and not overgrazed earlier in the season, this period can be considerably shortened.

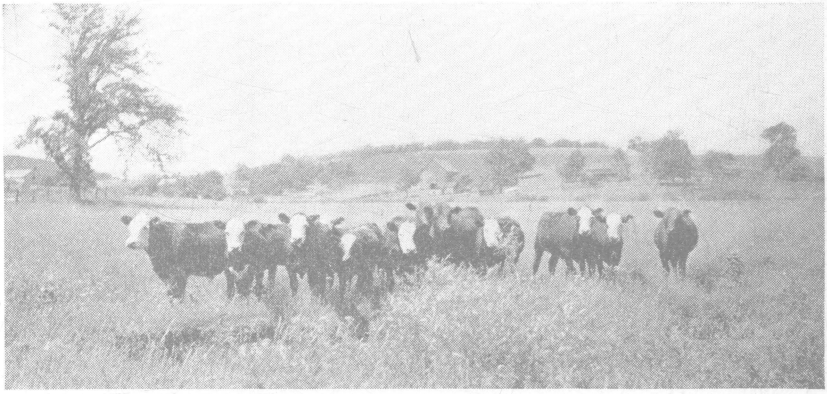


Fig. 17.—A reserve pasture for summer grazing on the farm of Ralph Yost of Perry County. Photo taken during the first week of July.

The application of nitrogenous fertilizers at intervals throughout the growing season has been mentioned, but the shortage of moisture frequently so limits the effectiveness of such applications that they cannot be generally recommended. It is true, however, that the more productive soils hold moisture better and use less moisture per unit of pasture produced.

Reserve Surplus Area.—A more or less common practice is to reserve an area with little or no grazing in June so that a surplus of pasture remains on the land for grazing in July. With the earlier grazing in May, maturity is to some extent delayed, thus leaving it a little more succulent in July than it would otherwise be at that period. Beef cattle men frequently hold certain areas ungrazed till late June. Naturally, the growth on such areas becomes dry and less palatable than young grass, and is not very well suited to milk production. Dairymen who have fertilized early spring grazing areas will find that early grazing has retarded maturity, and some grazing may be obtained from this area at the beginning of the mid-season shortage period.

Lespedeza in Permanent Pasture.—In the southern part of the state, Japanese and Korean lespedezas seeded in permanent pastures are very helpful in bridging the mid-season shortage. They make good growth during late July, August, and September, and reseed themselves for another crop the next year. The Korean lespedeza will not stand as close grazing as the Japanese, but it grows larger and matures earlier, thus enabling it to produce seed farther north. If the pasture is not overgrazed, both varieties will continue in the two or three southern tiers of counties indefinitely from one seeding. The Korean may be tried as far north as U. S. highway 40.

The seeding rate may be as low as 2 pounds of each kind of seed per acre. If this is evenly distributed it will in a few years thicken to the limit of the pasture. Where a heavy stand is desired at once, 7 pounds of each variety should be used. The inoculated seed may be broadcast on the sod in March or early April after the manner of the common clovers.

While the lespedezas provide some extra forage in the permanent pastures of the southern counties, they do not help farther north, and generally do not produce enough pasture in the southern tiers of counties. Consequently, other than permanent pastures must very frequently be depended upon.

Meadows as Summer Pasture.—Timothy, clover, alfalfa, or mixed meadows are commonly used for summer pasture. They should be cut early and not be grazed till there is at least 6 inches of fresh growth. The use of meadows in this manner not only provides pasture without the extra work of seeding a special crop, but it also produces a much higher quality of hay due to the necessity of cutting the hay earlier when the food value is higher.

Where alfalfa is to be cut for hay again in the late summer, grazing should be discontinued early in August; otherwise it may continue till early September without appreciable injury to the stand. It should be kept in mind that none of these special meadow pastures can be grazed close after the manner of a bluegrass pasture. Their best production depends upon good growth.

The value of alfalfa as a hay crop is well recognized. Attempts at grazing have frequently resulted in destruction of the stand. The crop should be grazed only when there is a growth of 6 inches or more, and the grazing should not be continuous. That is, either the first or third, or first and third crops should be cut for hay, and the remaining crops or crop only should be grazed.

When properly grazed, alfalfa is a valuable pasture crop (see Fig. 18). At the Michigan Experiment Station it was found that pastured first and second growth alfalfa gave a return in excess of $12 per ton on the dry basis when marketed through cows as butterfat at 22 cents per pound. Since utilization of the crop for hay and market involves much extra expense and risk of loss in curing, the return from pasture was much more than could have been expected from hay. The best evidence available seems to indicate that one need have no hesitancy from an economic point of view in grazing any of the common crops adapted to grazing, provided they are not required for winter feed and can be utilized by a good quality of livestock.

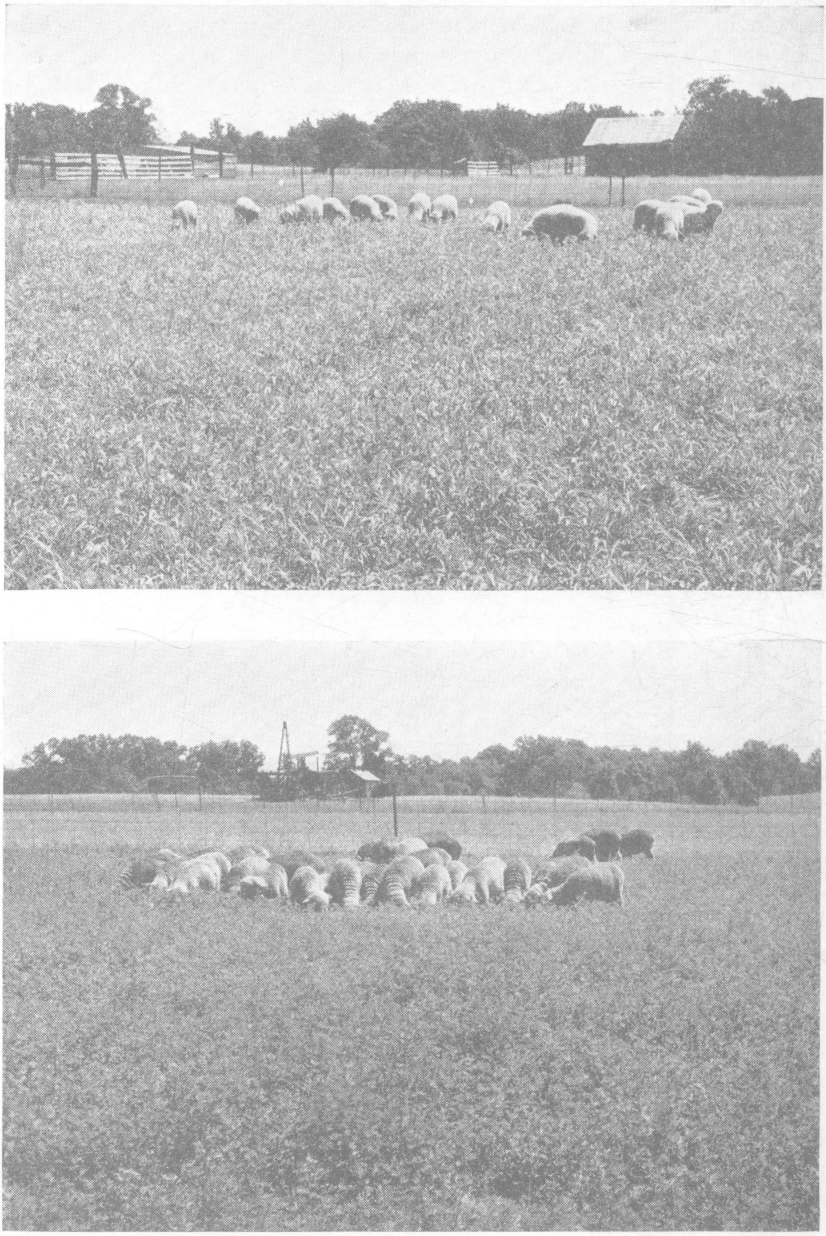


Fig. 18.—Two good summer pastures for sheep. Upper, Sudan grass; lower, second growth alfalfa. (Courtesy Ohio Agricultural Experiment Station.)

Sudan Grass for Summer Pasture.—Sudan grass is the most outstanding of the special crops that are available for summer pasture. One acre will provide grazing for three cows or the equivalent in other types of livestock from early July till frost. Twenty to 25 pounds of seed per acre, seeded just after corn planting during the latter part of May or early June, on a good soil carefully prepared and fertilized with 250 to 300 pounds of 4-12-4 fertilizer, will produce good grazing about 5 or 6 weeks after planting. Under emergency conditions the seeding may be made as late as the middle of July.

The seeding may be made through the wheat compartment of the grain drill. Mixing with cracked corn is necessary with some drills to prevent too heavy seeding. There is a tendency to cover too deeply, which should be guarded against. Growth may be materially increased by an application of 100 to 125 pounds of sulfate of ammonia or its equivalent in other nitrogen carriers, used as a top dressing in late July or early August.

The exact date to begin grazing will depend to some extent upon the season. While usually about 5 or 6 weeks from seeding will be required, this may vary from 5 to 7 weeks. The plants should be 8 to 12 inches high. A good plan is to provide two areas of Sudan grass on which the stock may be alternated. It is also desirable to turn stock off during wet weather, since otherwise they will injure the soil by tramping and may pull up many plants. Some farmers have a practice of preceding Sudan grass with rye or sweet clover, which provides early spring pasture the same season. After the rye or sweet clover has been utilized, the ground is plowed and prepared for Sudan.

Sudan grass has been most extensively used by dairymen, but it is also being used for sheep and other livestock with pleasing results (see Fig. 18). Its chief drawback is in the extra work required in preparation for the crop. Some injury to livestock, presumed to have come from grazing frozen Sudan, has been reported. We know of no authentic cases but suggest that grazing after frost be conducted with caution. The type of poison presumed to be developed by frost soon disappears with drying. The crop might therefore be made into hay with absolute safety.

Korean Lespedeza.—Korean lespedeza, in the southern third of the state, makes a good growth in late July, August and September, and is worthy of trial as a special summer pasture crop. Two-thirds as many acres as there are cows to graze should be provided. It may be seeded at the rate of 20 pounds per acre in oats or winter wheat, after the usual manner of seeding the clovers, and grazed after the grain crop has been removed. Late in the fall the ground may be disked very lightly and reseeded to wheat. The lespedeza, if not overgrazed, will reseed itself and again produce pasture following the next grain harvest. Thus wheat and Korean lespedeza pasture may be produced each year. If preferred, rye may be grown in the place of wheat and may be used for early grazing or hay rather than for grain.

Fall Pasture

Fall pasture is not generally a serious problem on farms with good rotation or permanent pastures, but where these are not available or where they are insufficient, other provisions are necessary. One hundred to 150

pounds of sulfate of ammonia, or the equivalent in other forms of nitrogen per acre, in the latter part of August will add materially to the fall growth of the rotation or permanent pasture area.

New Meadows.—New meadows very commonly make sufficient growth to justify some grazing during August and early September. This, however, should not be overdone, since a new meadow closely grazed may kill out badly during the winter. Sufficient grazing to prevent the clover coming in head may be of value to the meadow as well as provide pasture, on condition that there is good growth when winter sets in.

Sweet Clover.—If seeded in the spring sweet clover will, under favorable conditions, provide some fall pasture. The amount and earliness of spring production, however, is reduced by fall grazing. Consequently two areas, one for fall and one for spring, should be provided, or grazing should

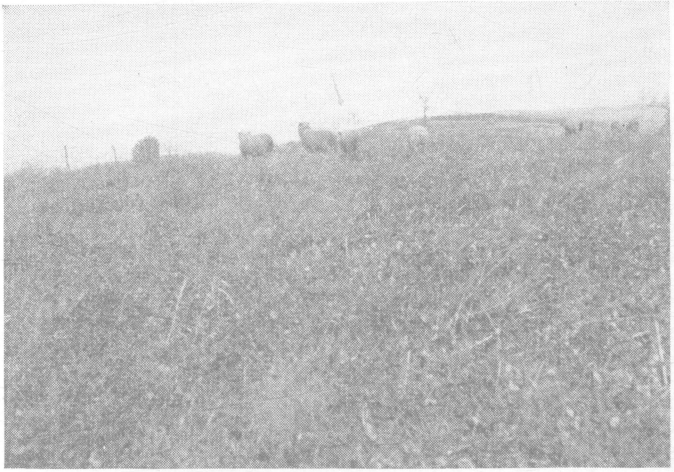


Fig. 19.—Sheep grazing in September on new meadow on farm of Ralph Davis, Gallia County. New meadows frequently make sufficient growth to justify some grazing during September.

be extremely light. The place and management of this crop was discussed under the heading of spring pastures (page 22).

Rye.—Seeded in August or September at the rate of 2 bushels per acre, rye will supply abundant late fall pasture. This same area may also be used for further grazing in the spring. Where this pasture is utilized by dairy cows it is well to remove the cows several hours before milking in order to prevent off flavors in the milk.

Adequate Pasture for the Entire Grazing Season

Just which of these various possibilities for the different periods should be utilized depends upon the kind of livestock, the type of farming, and the help and equipment available.

For the sake of illustration, some possible combinations are suggested in Fig. 20.

Frequently, permanent pasture areas are composed of more than 50 per cent weeds and wild grass unsatisfactory for grazing. These areas have resulted from lack of fertility and from improper grazing. From data given early in this publication it is evident that one very effective means of control and eradication of such vegetation is to improve the pasture through the use of lime (if needed), and fertilizer. This, combined with good grazing practice, is in fact the most effective means. Most of the common pasture weeds and wild grasses such as broom sedge, poverty grass, cinquefoil, plantain, daisy, tickle grass, and moss, tend to disappear rapidly when conditions are

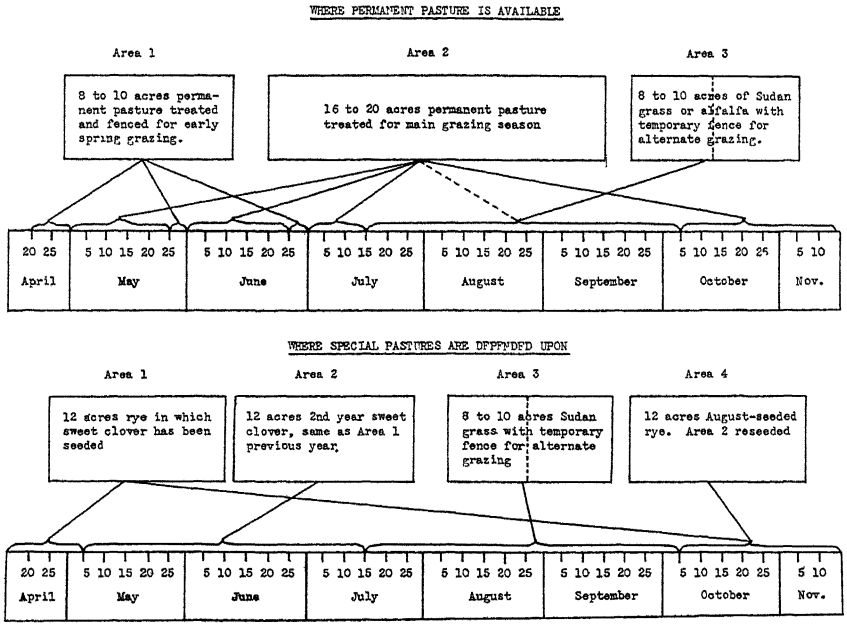


Fig. 20.—Suggested plans for pasture for 24 cows for the entire grazing season, including some of the types of pasture that might be used and when they would be available for grazing.

made ideal for the development of a vigorous sod of bluegrass or bluegrass and white clover.

There are, however, a number of other weeds such as mullein, thistle, horse nettle, iron weed, and briars that do not disappear so rapidly and further treatment is desirable for their control.

Mowing the pasture about the middle of June and again in early September will eliminate most of the remaining pasture-land weeds. There will occasionally be times when a mattock or even hand pulling may be necessary, but it is rare that weeds become a serious problem in a properly fertilized and grazed pasture that is mowed at least once a year. June mowing also tends to keep grass more uniform and provides a better growth of palatable vegetation during the latter part of June and the early part of July.

Undergrazing tends to encourage briars and other large type weeds, while overgrazing is sometimes in part responsible for the development of moss and small type weeds.

Rotational Grazing

The division of pastures into different fields and the rotation of livestock from one area to another has been practiced in Europe and in parts of the eastern states in America for many years. In recent years there has developed in Europe a new system of pasture management characterized by foreign authorities as one of the outstanding accomplishments of the last half century. This so-called "Hohenheim" system involves the following essential features: (1) the division of the pasture into a number of separate small fields or paddocks; (2) the top-dressing of these paddocks in rotation during the growing season with a generous amount of readily available nitrogenous fertilizer, each paddock receiving several treatments during a single season;

The Hohenheim System of Rotational Grazing

Paddock 1	Paddock 2	Paddock 3	Paddock 4	Paddock 5
Being clipped, harrowed with flexible pasture harrow, and treated with nitrogenous fertilizer, following the removal of dry cows and young stock to Paddock 2	Being grazed by dry cows and young stock, following the removal of high production cows to Paddock 3	Fresh succulent grass, being grazed by high production cows. Cows to be shifted to Paddock 4 in eight to ten days and replaced by dry cows and young stock.	Fresh succulent grass to which high production cows will next be turned, followed by dry cows and young stock a few days later.	Fresh succulent grass just getting started, following a recent treatment as indicated in Paddock 1.

Fig. 21.—The Hohenheim system: illustrating the status of the various paddocks as they might appear about May 25th with the second rotation of cattle in grazing. See text above for essential features.

(3) the grazing of the paddocks in rotation, the period of grazing being so timed as to take advantage of the flush growth of succulent palatable grass following the fertilizer treatments (see Fig. 21).

Experiments in Ohio indicate that in so far as beef cattle are concerned, the practice probably cannot be justified. On the dairy farm the situation is somewhat different. While beef cattle can well utilize the rather mature, high carbohydrate pasture herbage resulting from the uneven grazing characteristic of the continuously grazed area, this is not true of dairy cows. These animals need a more succulent, younger pasture herbage, high in minerals and protein, which can be better supplied by rotational grazing. It is also frequently desirable to divide the pasture area in several sections in order to keep separate certain classes of livestock.

Under such a system of rotational grazing it is customary to first graze for a period of a week to 10 days with milk cows or other kind of livestock requiring high protein feed, and to follow these with less exacting sorts such as dry cows, young stock, or sheep. If the area is not then evenly grazed, the

remaining clumps of tall grass are mowed down and the area given a rest for about 30 days, that the new growth may reach a height of about 4 inches when the first class of livestock is again turned in. In the meanwhile the various classes of livestock are moved in order to other pastures. Thus the different classes of livestock are rotated from area to area during the season. With this system the use of the pasture harrow for distribution of droppings is frequently desirable at the beginning of rest periods.

It is claimed that rotational grazing provides a greater quantity of high quality herbage, that the pasture is more completely utilized, and that the pasture is kept freer of weeds.

Establishing Permanent Pastures

It is advisable, in the case of most old pastures, to improve them without plowing. Plowing a steep slope may result in the washing away of the surface soil, leaving only the raw subsoil, on which the establishment of a profitable pasture is very difficult. Frequently, however, especially on the heavy soils of northeastern Ohio, there are badly depleted areas where no danger of serious erosion exists. Under such conditions, where the grass is badly run out, where weeds are a serious problem, or where poverty grass forms such a heavy sod that fertilizers cannot be incorporated, plowing and reestablishing is justified.

There are also many areas now in crops that should go into permanent pasture. The higher the productive level of such soils when they are seeded down, the better the pasture will be, the longer it will remain productive, and the greater will be the margin of profit.

Under such conditions the land should be manured, particularly over the thinner areas. It should then be plowed and limed in accordance with the lime requirement. This should be followed by preparation of a good seedbed, and the seeding of the pasture seed mixture in connection with a small grain nurse crop, accompanied with an application of 300 to 500 pounds of 2-14-4 or 20 per cent superphosphate per acre. If seeding is made with a spring seeded grain, the legumes and grasses may be all seeded at one time. If sown with a fall seeded grain, the grasses should be seeded in the fall and the legumes held over for spring seeding after the usual manner for clover in March or April.

Where the area to be seeded to permanent pasture is being farmed in a regular rotation, it may be seeded down in connection with the seeding of a grain crop after the usual manner of establishing a meadow, except that the fertilizer application should be much heavier, and lime in accordance with requirements should be incorporated.

On areas of extreme depletion, it may be desirable to plow in the spring and grow a green manure crop such as soybeans, which should be disked in for the seeding of the grass and nurse crop in the fall.

Where the plan fits better into the farm organization, the new seeding may be made alone in August on a smooth, firm seedbed with a light surface layer of fine soil. The use of lime and fertilizer would remain as already outlined.

When the seeding is made with a nurse crop in the fall or spring, the nurse crop may be removed green and made into hay or let mature for grain. The next year the area may be used either for hay or pasture. Grazing following the removal of the grain crop, and also the following year, should be light.

Since permanent pasture plants are rather slow in establishing themselves, it is desirable to include seed of certain hay type plants which will give better returns the first few years, whther it be used first for hay and then for pasture or for pasture from the start.

The kind of seed to include in the seed mixture may be varied according to choice of the individual but as a guide two mixtures are suggested in Table IV, one for soils of a lime content known to be satisfactory for alfalfa and one for soils not so high in lime content. The former might be regarded as suited primarily to western Ohio and the latter to eastern Ohio. There will, however, be many exceptions in each case.

Table IV. Suggested Pasture Seed Mixtures in Pounds per Acre

Kind of Seed	On High-lime Soils	On Medium-lime Soils
Timothy or orchard grass or parts of each	5	5
Alfalfa	5	
Medium red clover		4
*Alsike clover	2	3
White clover	1	1
Kentucky bluegrass	6	6
Red top	2	2

* In the southern part of the state 2 pounds of Korean and 2 pounds of Japanese lespedeza may be stubstituted for the alsike clover or used in addition thereto.

In establishing permanent pastures it is well to keep in mind that a good pasture is a valuable crop and demands a good soil. In some sections it is a general practice to prepare for alfalfa, and permit the area to go from this crop to permanent pasture.

Summary

1. If Ohio's livestock is to be maintained in the most healthy condition and the maximum of farm profits is to be realized, pastures must be made to provide more of the feed supply.
2. The chief pasture problems on Ohio farms are: How to produce sufficient high quality pasture; how to produce it at the time it is needed; how to graze and manage the pasture that it may be maintained in a productive condition.
3. Lands too steep or rough to be gotten over with farm machinery necessary in the process of improvement and care should not be retained in pasture area. Such areas may be more profitably utilized as forest lands.
4. Land areas without vegetative cover may lose, through soil erosion, 200 times as much soil as areas covered with a good bluegrass sod. Erosion control alone frequently justifies the cost of pasture improvement.

5. The fertilization of pasture not only greatly increases the percentage of desirable plants but also decreases the percentage of weeds and bare ground.
6. The pasture cost of producing meat and milk may be reduced through pasture fertilization, provided the increased pasture produced is properly utilized.
7. Permanent pastures may be made to provide as much feed as rotation crops and at a lower cost. There should be no hesitancy in utilizing level land for pasture production if it is so needed and can be spared from the amount required for the production of necessary winter feeds.
8. The maintenance of good permanent pasture is dependent upon a satisfactory program of liming, fertilizing and general care.
9. Nitrogenous fertilizers may profitably be used on good permanent or special pasture crops if used at the right time and if the resulting product is properly utilized.
10. It is not necessary to replow old pastures in order to improve them.
11. Old meadows utilized as pastures may be treated in a manner similar to permanent pastures.
12. Manure, if available, may be profitably utilized on pasture lands.
13. Permanent and meadow pastures have a natural tendency to make the heaviest production in May and June with insufficient production in July and August. These should be supplemented with special pastures such as Sudan grass for summer grazing.
14. Alfalfa provides splendid summer pasture and may be used instead of Sudan grass where the soil is suited to this crop.
15. Common and Korean lespedezas are valuable additions to thin pasture lands in the southern parts of the state, but are not adapted to the northern half of the state.
16. Sweet clover is of greatest value in the western part of the state where the land is more adapted to this crop. In this section it probably has no superior among the special pasture crops for May and June production. However, like bluegrass, sweet clover does not hold up in July and August.
17. Rotational grazing, if carefully managed, frequently has advantages over continuous grazing, particularly with dairy cattle and sheep.

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